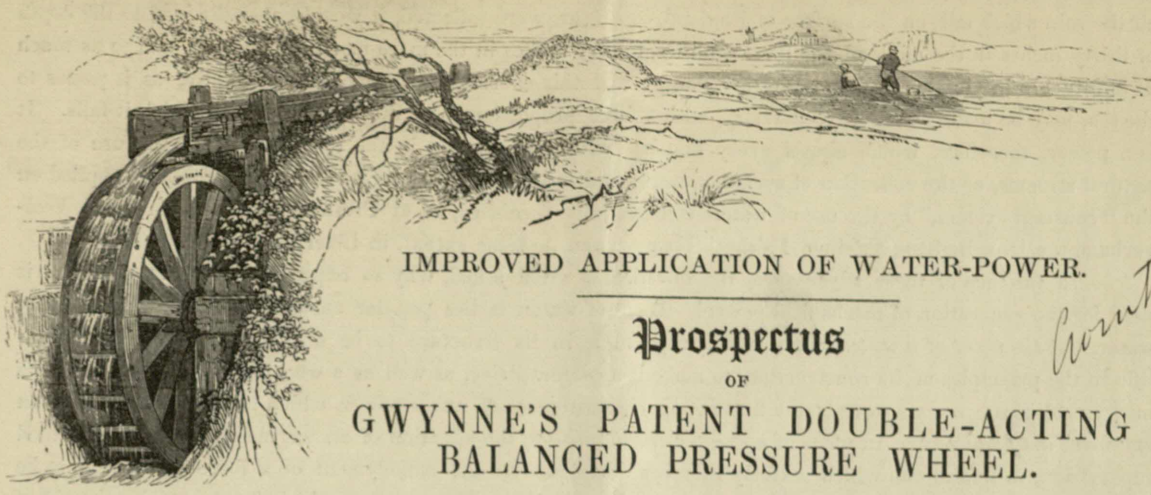
IMPROVED APPLICATION OF WATER-POWER.

PROSPECTUS

OF

GWYNNE'S PATENT DOUBLE-ACTING BALANCED PRESSURE WHEEL.



IMPROVED APPLICATION OF WATER-POWER.

Prospectus

OF

GWYNNE'S PATENT DOUBLE-ACTING BALANCED PRESSURE WHEEL.

IN a manufacturing country like Great Britain, the economic employment of water-power is an object of national importance. Leaving out of consideration its minor applications, if we analyse the power employed in England, in the Spinning and Weaving Factories, we shall have very conclusive evidence on the point. In the estimate of the state of the cotton manufacture, in 1833, drawn up by Mr. Baines, of Leeds, he considers that of the 44,000 horse-power employed, there are—

Steam-power............................	33,000
Water-power	11,000

But we have much more complete and more accurate numbers given in the Returns of the Factory Inspectors for 1839, of which the following is a summary:

The total mill-power in factories, subject, at that time, to inspection in England, was 83,264 horse-power.

Of these there were—

62,846	horse-power	... Steam:
20,418	„	... Water:

Coinciding with Mr. Baines' general view of three-fourths steam, and one-fourth water.

In Lancashire, where coals are so cheap, it might be supposed that water-power would be unused, but it is ascertained, that the—

Total mill-power inspected in Lancashire, is 36,446 horse-power: consisting of—

Steam..................	32,123	horse-power
Water	4,323	„

Thus one-ninth of the total mill-power of Lancashire is water-power. This shows how water-power is valued. In fact, advantage is taken of it to the full extent permitted by the oftentimes imperfect, wasteful, and costly machinery now in use. But in order to estimate how far water-power is valued, we must learn, not merely how much is used, but how much is left unused. It is calculated that the theoretical water-power of Lancashire is represented by 72,600 horse-power, taken as working continuously. Now, as only 4,323 horse-power is economised, making but 6 per cent. of the entire power available for industrial occupation, it follows that the power of 68,277 horses is allowed to run to waste, or more than twice the steam-power of the whole county.

The case in the agricultural counties is much worse, as most farmers, millers, fullers, and paper-makers, —who usually seek the rural districts—can testify.

Water-power, when administered by unskilful hands, is generally either wasted or misapplied, through the medium of clumsy machines, which are one-half their time choked with water, and at all times literally forced to work "against tide," delivering but little transmissive power, and that, too, in an uncertain and intermittent manner.

We are entitled, therefore, to repeat, that "THE ECONOMIC EMPLOYMENT OF WATER-POWER IS AN OBJECT OF NATIONAL IMPORTANCE." But the value of this assertion becomes more apparent, when it is considered, that if

26.11.64.

all the rain which falls on the surface of England, in a year, were collected, it would cover the land to the depth of thirty inches in the midland and level counties, to fifty inches in the more maritime districts, and to as much as 300 inches in Cumberland and Westmoreland.* Of this enormous quantity, fully one-third, as it passes to the sea, may be made available to industry, with a force proportioned to the height through which it falls. It is a power, therefore, which almost every one has within his reach: in the open country by the use of the natural streams, or the collection of surface waters; and in those towns, now increasing in number, supplied on the "constant system," by the use of waters commercially furnished, as at Preston, Ashton-under-Lyne, Wolverhampton, Nottingham, Stirling, Paisley, Glasgow, and, to some extent, in Liverpool.†

In the face of these advantages, the question is often asked, why so expensive an agent as steam is used for the generation of mechanical power? Want of water, is the popular answer. But it is not want of water, but *the want of a water-wheel,* sufficiently simple in its structure to be durable, but sufficiently scientific in the principles of its construction, to make it a *compensating,* as well as a working engine; fitted in its mechanical arrangements to meet the fluctuating circumstances of water-power, which has led to the use of an *expensive artificial power,* in place of a *cheap natural one*—to the adoption of an engine which requires skilled supervision, in lieu of one which scarcely requires oversight—to the employment of a force which cannot be economically used under a less rate of expenditure than six horses, for purposes which do not require the aid of three; while a power is at hand, capable of profitable adaptation to the smallest as well as the largest requirements of industrial labour.

To remedy these evils, and to furnish the public with an engine of universal application, of constant action, and of great power, has been the object of the Patentee of the Double-acting Balanced Pressure Wheel, and in fulfilling these requirements, it is admitted he has entirely succeeded. But before calling specific attention to his invention, the following notice of the old-fashioned forms of wheels, generally in use, may be of service to unprofessional readers, in leading them to a clearer appreciation of its advantages.

Water engines may be reduced to four classes. In the first, the water acts by its *weight;* of this kind is the "*overshot* water-wheel." In the second, the action is by *impulse,* as in the "*undershot* wheel." In the third, it is by *pressure,* as in the "*water-pressure machine.*" In the fourth, it is by reactive pressure, as in Barker's mill; and similarly, *reactive impulse* gives origin to the horizontal or "tourbine" wheel.

The "Overshot Water-wheel" is the most ancient engine of water-power. It belongs to an early age of civilization; and, as might be expected, it possesses no power of adaptation to meet variable circumstances. Its construction, however, requires considerable mechanical skill that its powers may be brought fully into play;—the form of the buckets; the quantity of water let into each bucket; the point of the circumference at which the water is to be let on; the exact centring of it, so that its motion may be absolutely uniform;—all these are points which require an amount of scientific skill but rarely possessed by provincial manufacturers; and it follows, that on faults being made in a prime mover, the injurious results are very serious. Moreover, it must be recollected that the water should act only by its weight; the principle upon which its maximum action

---

* *Vide* Dr. Miller on the Rain Fall of Cumberland and Westmoreland. Philosophical Transactions, 1849.

† Report of the General Board of Health on Water Supply, 1851, in which the Commissioners say—"There are various convenient and economical modes of applying water to gain intermittent power. A warehouseman, for instance, might desire the power of a small steam engine to work a crane to unload or load two or three carts or waggons; but it would not be worth his while to keep a steam engine in readiness for such a service during the whole day. Steam engines, moreover, require skilled superintendence. With a constant supply of water, a tap merely turned, and the hydraulic pressure becomes a means of motive power appliable at once and capable of being immediately discontinued." Mr. P. Holland, who gave evidence before them, thus illustrates the convenient application to industrial purposes of the hydraulic power derivable from the constant supply: "At present," he says, "many tradesmen employ very small steam engines for purposes that may be almost as cheaply accomplished by hand, for instance, coffee grinding. There are many purposes for which steam might be substituted for manual power with advantage, were it not for the cost of the skilled labour required to attend to it, and the expense and trouble of keeping up the steam when the power is not wanted. IF SOME HYDRAULIC ENGINE, SUCH AS THE TOURBINE, WERE EMPLOYED AND WORKED BY WATER FROM THE PIPES, which could be set at work and stopped in an instant, which consumes no power except when at work, which requires no skilful mechanic to work it, and is quite free from risk, from fire or explosion, there is no doubt that numerous applications of such power would be introduced, which are as yet scarcely thought of. It would be easy to work cranes, and hoists for raising and lowering goods and persons in warehouses, where the occasions for their use are not sufficiently numerous to make a steam engine economical. I have known a warehouseman pay £20 a year rent for the occasional power derived from a neighbour's steam engine for working his packing presses. Such an instrument would work presses in the smaller printing offices, where it is not worth while having a steam engine. Turners might work their lathes, and smiths their bellows, by water-power; chaff might be cut, and oats and beans crushed, by the same means. In fact, it is impossible to mention all the various uses to which it might be applied, if water were supplied constantly and at high pressure."

depends being that the water should enter the wheel without impulse, and should leave it without velocity. The fulfilment of such conditions greatly narrows its use, and makes it undesirable in all cases of economic procedure. Here, however, an honourable exception must be made. Mr. Fairbairn, to whom the public is so largely indebted for many valuable discoveries, both in the principles and practice of engineering science, has invented a modification of the Overshot Wheel, entitled by him the "VENTILATING WATER-WHEEL," in which all that ingenuity could suggest has been brought to bear upon its improved construction. Reflecting, however, as it does, the highest credit upon his mechanical skill, it must still be regarded as necessarily defective, when compared with that to which we are about to direct attention.

The "UNDERSHOT WHEEL" is chiefly employed in level districts, where, though the quantity of water may be large, the height of fall may be but a few feet. The water acquiring a velocity from rushing down an inclined race, strikes the float-boards near the bottom of the wheel, and communicates to the machinery a portion of its own motion. Now this Undershot Wheel is a most imperfect machine. In the Overshot Wheel, the theoretic value of the water is equal to its weight multiplied by its height of fall, and of this force, two-thirds may be taken as the average actually available in practice. In the Undershot Wheel, on the other hand, the theoretic power is but half the weight of the water multiplied by its height of fall; and of this scarcely more than one-half is available in practice. Hence the final performance of the Undershot Wheel is less than one-third of the total theoretic power of the water expended. This machine should, from its gross want of economy, never be used where any other is practicable.

The "BREAST WHEEL" has float-boards like the Undershot, but instead of moving in an open race, revolves in a carefully constructed channel, the sides of which are so closely fitted to its frame, as, with the float-boards, to form in some degree a set of buckets. The water is let on somewhat below the axis, and entering the channel with some velocity, it acts at once by weight and impulse. The power of the Breast Wheel is intermediate to those of the wheels already noticed. It is in fact compounded of the two. The available working effect may be taken at 55 per cent., or little more than half the calculated force of the water.

Of the "HORIZONTAL WHEELS," the "TOURBINE" is the most improved form. It is an engine of remarkable efficiency, invented in France about a century since, by M. Fourneyron. The Tourbine is a horizontal wheel, furnished with curved float-boards, on which the water presses from a cylinder which is suspended over the wheel, the base of which is divided by curved partitions, that the water may be diverted in issuing, so as to produce upon the curved float-boards of the wheel its greatest effect. The construction of the machine is simple; its parts not liable to go out of order, and as the action of the water is by pressure, the force is under the most favourable circumstances for being utilized.

The effective economy of the Tourbine, when well constructed, and judiciously placed, considerably exceeds that of the Overshot Wheel. But this economy in the Tourbine is accompanied by some conditions which render it peculiarly valuable. In an ordinary water-wheel you cannot have great economy of power without very slow motion, and hence where high velocity is required at the working point, a train of mechanism is necessary, which causes a material loss of force. Now, in the Tourbine, the greatest economy is accompanied by rapid motion, and hence the connected machinery may be rendered much less complex. In the Tourbine, also, a change in the height of the head of water alters only the power of the machine in that proportion, but the whole quantity of water is economised in the same degree. Thus, if the Tourbine be working with a force of ten horses, and that its supply of water be suddenly doubled, it becomes of twenty-horse power; if the supply be reduced to one-half, it still works five-horse power: while such sudden and extreme changes would altogether disarrange water-wheels which can only be constructed for the minimum, and allow the surplus to go to waste.

But, in addition to these advantages, the Tourbine possesses others, which, when it is used as a tidal wheel, are altogether unique. The acting force in the Tourbine is proportional to the difference between the pressure of the water inside and outside of its cylinder. It is no matter how deep it may be under water, provided this difference is kept up. It works with the same effect; delivers out in practice the same per centage of the theoretic power; and hence realizes absolutely the chief conditions necessary for the perfect utilization of the motive power of our tides. The Tourbine is, therefore, peculiarly the machine for economising tidal power, although it must be remarked it will only work with one flow of the tide.

Having made these remarks, it now only remains for us to state that the new Double-Acting Balanced Pressure Wheel is a modification of the Tourbine, with such additions and improvements as make it the most perfect wheel for all circumstances which it seems possible to desire. It prevents the waste of power attendant on the use of any of the machines we have enumerated; it works both with the flux and reflux of the tide; and it is of greater power than any other wheel, as will be seen from the following comparison :—

WHEEL.	ECONOMY OF POWER.
Undershot	about 33 per Cent.
Breast	„ 55 „
Overshot	„ 70 „
Tourbine	„ 80 „
Gwynne's Double-acting	„ 85 „

Possessing these paramount advantages,

GWYNNE'S DOUBLE-ACTING BALANCED PRESSURE WHEEL,

Is offered to the public in the confidence, that both commercially and practically, it will be found to give satisfaction where adopted, and to secure the following advantages :—

First :—A great saving in the amount of water consumed by the best wheels now in use.

Second :—A saving of 33 to 50 per cent. on the first cost; the amount varying, of course, with the situation in which the wheel might be placed.

Third :—The advantage that, when used as a tidal wheel, it would maintain a *continuous movement, both with the rise and fall of the tide;* giving, in cases in which the load is proportioned to the head of water, a nearly uniform motion to the machinery.

Fourth :—The desideratum, so long needed, that when erected on mill-streams subject to floods or large accumulations of back water, its operation is as perfect as under the most favourable circumstances.

Last :—A *perfect adaptability* to all situations, and a simplicity, compactness, and stability of construction, by which a non-liability to get out of order is guaranteed.

DESCRIPTION OF THE WHEEL.

The great improvement effected by the Patent Double-Acting Balanced Pressure Wheel, consists of a peculiar modification of that form of water-wheel, known as the re-acting or tourbine wheel, adapted to either a constant or graduating head of water, and is particularly applicable to tide water purposes, whereby the wheel will work with the tide ascending a river or inlet of the sea, or under a graduated head of water, with the tide descending and going back into the sea. A mode of regulating the variable velocity of the wheel, so that the machinery driven by it shall always work at the same velocity, is also connected with the apparatus.

The adjoining Plate represents four views of the wheel.

Fig. 1 is a vertical sectional elevation of the wheel, with its regulating valve. Fig. 2 is a plan, partly in horizontal section. Fig. 3 is a plan of the casing and regulating valve-chest detached; and Fig. 4 is an enlarged detail of a portion of the bucket-ring. In this arrangement, the wheel is intended to be worked by the rise and fall of tidal waters. If adapted for streams, the bottom case is removed, and the water, after entering the wheel, falls through the opening into the tail race. The water is admitted from the level, A, by the regulating slide valve, B, to the water-way, C, in communication with the annular space, D, round the wheel. This case encircles the ring of buckets or partitions, E, for the ingress and egress of the water to work the wheel either way of the tide. These partitions are carried by the arms, F, fast on the vertical shaft, G, which passes upwards to drive the machinery.

The peculiar feature of invention consists in the shape of the partitions between each water-way, which are so arranged as to present a direct surface to the action of the water in its passage through, whether the water passes from the level of the dam, A, to the tail race, or the reverse. The annular space, E, containing these partitions, is cased at top and bottom, both surfaces being turned true in the lathe, and working the one against the lower, and the other against the upper surface of the annular casing. When employed as a tidal wheel, the connection between the main spindle and the first motion horizontal shaft, by an arrangement of three bevel wheels, with an adjustable clutch-box, for accommodating the direction of motion of the gearing to the reverse motion of the wheel, when the tide turns. The variation in the rate of the wheel, due to the varying head of water as the tide rises or falls, is compensated for by a double-cone pully action, actuated by a float working on the head water level; as the rate of the wheel decreases from the diminished head of water, the fall of the float changes the relative position of the strap on the cone pulleys, in order to give the driving shaft a higher proportionate speed.

GWYNNE'S WATER-WHEEL.

Fig. 1.

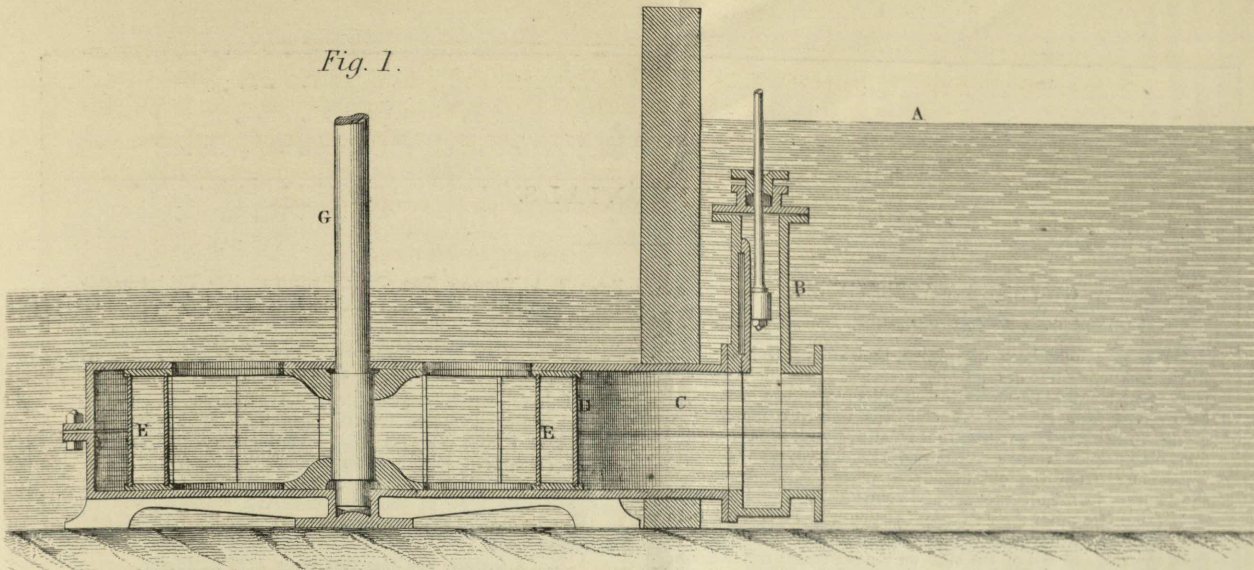


Fig. 2.

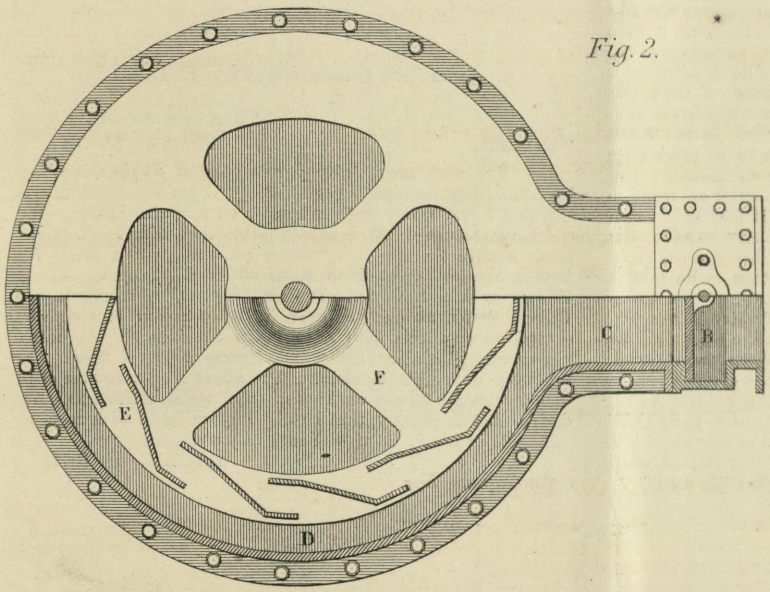


Fig 3.

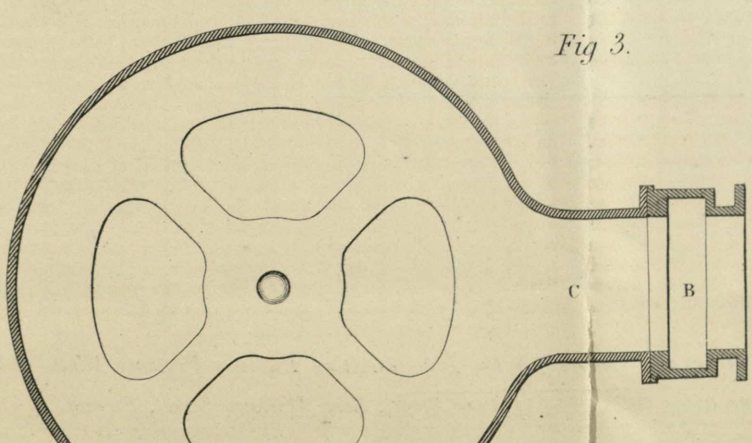
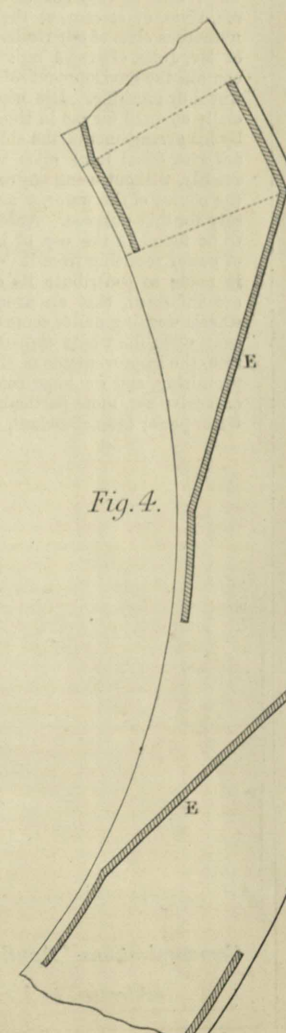


Fig. 4.



TESTIMONIALS.

GWYNNE'S WATER-WHEEL.

Extracted from the Patent Journal, February 15th.

"We have long been of opinion, that water-power, so economical and accessible, has not been employed in this country to the extent it might be, and with the full advantages which should be derived from it. For hitherto, the immense power to be gained from tidal rivers, has, in a great measure, been neglected and manufacturers have contented themselves with deriving water-power from the old fashioned undershot, breast, or overshot wheels, in inland streams and rivulets. It would be superfluous to dilate upon the extent of the power to be derived from the judicious employment of the ebb and flow of tidal rivers, or from the rise and fall of the tide on the sea coast; nevertheless, the fact is clear, that this power is *not* adequately employed.

"The reason, perhaps, for this, may be found in the inefficiency of the mechanical means ordinarily used for obtaining hydraulic power; and if we can draw the attention of persons who may need motive power to improved means of obtaining it from water, and thereby enable them to take full advantage of the sea, river, or stream, at their doors, we may do a service to a numerous class of our readers. The specification of the patent of Mr. John Gwynne, reported in this number, appears to us to contain the development of much improvement in the water-wheel or tourbine. His wheel would appear to be more especially adapted for use in tidal rivers, from the circumstance that, by his arrangements, the ebb and flow of the water are made to act with equal force upon the wheel. For it may be changed readily, without using any complicated machinery, so as to meet the course of the water, a simple clutch box being alone necessary for this purpose. Another great advantage, as we take it, to be found in the use of this wheel, is the complete economy of power resulting from it,—for every drop of water (so to speak) is made to contribute its quota of force to the machine. We are informed, that an average of power, taken from several wheels working under some disadvantages, gave eighty-seven per cent. upon the whole *theoretical* power of the water. At any rate, the improvements of Mr. Gwynne appear to us to be highly promising, and we hope soon to hear, that the new wheel is in extensive use, more particularly in a country like Ireland, where water-power is so abundant, and (unhappily) so little used."

From T. A. Yarrow, Esq. Civil Engineer, late Bridgemaster and Surveyor to the County of Cheshire.

"Palace Chambers, St. James Street, London,
"My Dear Sir, *February* 20, 1851.

I have carefully examined the construction of your "Double-Acting Pressure Wheel," and have no hesitation in stating that I consider it a most ingenious, economical, and practical machine, for using water as a motive power.

It possesses many advantages over the clumsy and wasteful wheel generally used in the manufacturing districts, and my conviction is that the mill owners will rapidly recognise its commercial value.

I remain, my dear Sir, yours very faithfully,
T. A. YARROW."

To J. Stuart Gwynne, Esq., C.E.

From Paul Hodge, Esq., Civil Engineer.

"9, *Adam Street, Adelphi,*
"Dear Sir, *February* 24, 1851.

You wish me to give you an opinion on your brother's Double-Acting Balance Wheel. Before I do so, allow me to say, that I very rarely give an opinion on a new invention.

I have examined the drawings submitted to me, and do certainly admire the simplicity of its construction. I think the form of bucket superior to those of M. Fourneyron, Calvin Wing's, or Mr. Dewey's. During 15 years' residence in the United States as an Engineer, I had occasion to construct several water-wheels, and have made them in all the forms known under the above names, but I must confess I think your brother's preferable to either; but above all, in respect of its easy application to the working of tidal water, a thing so much desired in this country, that I think he must meet with success.

Yours very respectfully,
PAUL R. HODGE."

John Gwynne, Esq.

Communications, Applications for Licences and Orders for the Double-Acting Balance Pressure Wheel to be addressed to Mr. John Gwynne, at the Office, No. 1, *Agar Street, King William Street, Strand.*

DIAMETER OF WHEELS—Quantity of Water used under Heads from 2 to 30 feet, and the nominal and actual Horse-power of the various Wheels.

Diameter of Wheels.	Cubic feet of water used with 2 feet head per minute.		Ditto 4 feet.		Ditto 8 feet.		Ditto 12 feet.		Ditto 16 feet.		Ditto 20 feet.		Ditto 25 feet.		Ditto 30 feet.	
	Horse-power under various heads, and with wheels of different diameters.															
24 inch	C. F. 67		C. F. 100		C. F. 141		C. F. 170		C. F. 200		C. F. 223		C. F. 251		C. F. 270	
	actual. ·109	theoret. ·128	actual. ·604	theoret. ·710	actual. 1·806	theoret. 2·124	actual. 3·295	theoret. 3·876	actual. 5·168	theoret 6·080	actual. 7·183	theoret. 8·450	actual. 10·094	theoret. 11·875	actual. 13·082	theoret. 15·390
30 „	91		130		187		227		266		297		334		362	
	·291	·342	·838	·985	2·421	2·848	4·364	5·134	7·909	8·128	9·605	11·300	13·526	15·912	17·670	20·670
36 „	135		200		282		341		400		427		502		540	
	·437	·513	1·292	1·520	3·652	4·296	6·590	7·752	10·336	12·160	13·328	15·680	21·197	24·937	26·363	30·780
42 „	436		·647		911		1103		1294		1446		1624		1747	
	1·420	1·662	4·182	4·920	11·792	13·872	21·803	25·650	33·463	39·368	47·250	55·000	65·609	77·187	87·210	102·600
48 „	675		1000		1493		1844		2000		2235		2510		2686	
	2·176	2·560	6·460	7·600	19·278	22·684	35·757	42·066	51·680	60·800	72·233	84·980	101·342	119·225	130·089	153·045
60 „	1215		1800		2538		3067		3600		4023		4518		4860	
	3·915	4·617	12·070	14·200	32·783	38·568	59·446	69·936	93·024	109·440	129·923	152·850	182·474	214·675	388·085	456·570
72 „	1620		2400		3384		4092		4800		5364		5620		6480	
	5·233	6·156	15·504	18·240	43·735	51·452	79·311	93·306	123·832	145·920	173·290	203·870	236·908	266·950	311·920	369·360
84 „	2700		4000		5640		6958		8000		8940		10,040		10,800	
	8·721	10·260	25·840	30·400	72·678	85·728	134·834	158·628	206·720	243·200	286·637	337·220	405·365	476·900	523·260	615·600
96 „	4050		6000		8460		10,230		12,000		13,410		15,060		16,200	
	13·051	15·354	39·120	45·600	109·412	128·720	198·258	233·244	310·030	264·800	433·148	509·580	608·048	715·350	780·640	918·400

HRs
23.7.76